REMARKS

Reconsideration and allowance of the above-referenced application are respectfully requested.

Section 112 rejections

Claims 1-59 and 76-115 were rejected under 35 U.S.C. 112, first paragraph, for allegedly not providing support for a second non-gettering heat treatment.

Applicants respectfully traverse the rejections.

The claims have been amended to recite that gettering occurs during the second heat treatment.

Double patenting rejections

Claims 1-59 and 76-115 were rejected under the judicially created doctrine of obviousness-type double patenting as allegedly being unpatentable over claims 1-31 of U.S. Patent No. 5,700,333 to Yamazaki et al. ("the '333 patent").

The Action states in the Response to Applicants' Arguments section that since claim 1 of the '333 patent recites a layer and a region, then the region cannot be considered an entire layer. Applicants disagree with this reading. Claim 1 recites "forming a gettering layer on or a gettering region within said semiconductor layer after said crystallizing, said gettering layer containing phosphorus." The claim allows for a distinct gettering layer on or a gettering region within the semiconductor layer. The only regions described in the patent are "depth-wise" regions (see col. 6, lines 44-46), which could cover the entire area of the semiconductor layer, and Applicants submit that this is the intent of the teaching of the '333 patent. Applicants submit herewith a drawing illustrating the

difference between the method of the '333 patent and the present invention.

There is no disclosure of an island-like gettering region on the silicon layer in the '333 patent. Accordingly, Applicants submit that claims 1-59 and 76-115 are patentably distinct from claims 1-31 of the '333 patent.

The Action refers to US 6,251,712 and US 5,961,743 as teaching that the metal will move horizontally towards a small gettering area. Since these patents were not used in the Double patenting or Section 103 rejections, Applicants will not address them here. However, Applicants request that the specific portions of the patents describing these teachings be identified.

Section 103 rejections

Claims 1-16, 76-77, 82-108 and 112-115 were rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over the '333 patent.

Claims 17-59, 75, 78-81 and 109-111 were rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over the '333 patent in view of Zhang et al (US 5,569,936).

Applicants submit that claims 1-16, 76-77, 82-108 and 112-115 are allowable over the '333 patent for the reasons stated above in the Double patenting rejections section.

Zhang et al is merely cited for its disclosure of using lasers to crystallize amorphous silicon. Accordingly, Applicants submit that claims 17-59, 75, 78-81 and 109-111 are also allowable over the '333 patent and Zhang et al. for the reasons stated above in the Double patenting rejections section.

Information Disclosure Statement

It is respectfully requested that the previously filed Information Disclosure Statement of September 24, 2002 be accepted and considered under Rule 97(c)(2). Applicants enclose a copy of a check in the amount of $180 which was submitted for payment of the Information Disclosure Statement. In addition, a copy of the return stamped postcard is also enclosed indicating that the check was, in fact, received by the Patent Office.

Please apply any charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

Date: 4-30-03

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VERSION TO SHOW CHANGES MADE

In the Claims:

The claims have been amended as follows.

1. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film comprising silicon over a substrate having an insulating surface;

providing the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film while a second portion of the crystalline semiconductor film is not provided with the impurity element;

wherein the first and second portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

performing a second heat treatment for gettering so that the element contained in the second portion is moved to the first portion in a direction parallel to the insulating surface; and

patterning the crystallized semiconductor film to form a crystalline semiconductor island in the second portion thereby removing the first portion of the crystalline semiconductor film;

forming an active layer of the thin film transistor using the crystalline semiconductor island,

wherein the second heat treatment is performed in a temperature range not exceeding a glass transition point of the substrate.

9. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film comprising silicon over a substrate having an insulating surface;

selectively providing a first portion of the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film, so that a crystallization proceeds from the first portion in a lateral direction to the insulating surface;

introducing an impurity element belonging to Group 15 into a second portion of the crystalline semiconductor film while a third portion of the crystalline semiconductor film is not provided with the impurity element;

wherein the second and third portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

performing a second heat treatment for gettering so that the element contained in the third portion is moved to the second portion in a lateral direction to the insulating surface; and

patterning the crystalline semiconductor film to form a crystalline semiconductor island in the third portion thereby removing the second portion of the crystalline semiconductor film;

forming an active layer of the thin film transistor using the crystalline semiconductor island,

wherein the second heat treatment is performed in a temperature range not exceeding a glass transition point of the substrate.

17. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film comprising silicon over a substrate having an insulating surface;

providing the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film;

irradiating a laser light or an intense light to the crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film after the irradiating step, while a second portion of the crystalline semiconductor film is not provided with the impurity element;

wherein the first and second portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

performing a second heat treatment for gettering so that the element contained in the second portion is moved to the first portion in a lateral direction to the insulating surface;

patterning the crystalline semiconductor film to form a crystalline semiconductor island in the second portion thereby removing the second portion of the crystalline semiconductor film;

forming an active layer of the thin film transistor using the crystalline semiconductor island,

wherein the second heat treatment is performed in a temperature range not exceeding a glass transition point of the substrate.

25. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film comprising silicon over a substrate having an insulating surface;

selectively providing a first portion of the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film, so that a crystallization proceeds from the first portion of the amorphous semiconductor film in a lateral direction to the insulating surface;

irradiating a laser light or an intense light to the crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a second portion of the crystalline semiconductor film after the

irradiating step, while a third portion of the crystalline semiconductor film is not introduced with the impurity element;

wherein the second and third portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

performing a second heat treatment for gettering so that the element contained in the third portion is moved to the second portion in a lateral direction to the insulating surface;

patterning the crystalline semiconductor film to form a crystalline semiconductor island in the third portion thereby removing the second portion of the crystalline semiconductor film;

forming an active layer of the thin film transistor using the crystalline semiconductor island,

wherein the second heat treatment is performed in the temperature range not exceeding a glass transition point of the substrate.

45. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film comprising silicon over a substrate having an insulating surface;

providing the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film while a second portion of the crystalline semiconductor film is not provided with the impurity element;

wherein the first and second portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

performing a second heat treatment for gettering so that the element contained in the second portion is moved to the first portion in a lateral direction to the insulating surface;

patterning the crystalline semiconductor film to form a crystalline semiconductor island in the second portion thereby removing the first portion of the crystalline semiconductor film;

forming a gate insulating film over the crystalline semiconductor island;

forming at least one gate electrode comprising a metal on the gate insulating film;

doping an impurity element into at least a second portion of the crystalline semiconductor island to form a lightly doped drain region; and

forming at least a source region and a drain region by doping an impurity element into third portions of the crystalline semiconductor island,

wherein the second heat treatment is performed in a temperature range not exceeding a glass transition point of the substrate.

52. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film comprising silicon over a substrate having an insulating surface;

providing the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film while a

second portion of the crystalline semiconductor film is not provided with the impurity element;

performing a second heat treatment for gettering so that the element contained in the second portion is moved to the first portion in a lateral direction to the insulating surface;

patterning the crystalline semiconductor film to form a crystalline semiconductor island in the second portion thereby removing the first portion of the crystalline semiconductor film;

forming a gate insulating film over the crystalline semiconductor island;

forming at least one gate electrode comprising a metal on the gate insulating film;

doping an impurity element into at least a second portion of the crystalline semiconductor island to form a lightly doped drain region;

forming at least a source region and a drain region by doping an impurity element into third portions of the crystalline semiconductor island;

forming an interlayer insulating film comprising silicon over the gate electrode;

forming an interlayer insulating film comprising an organic resin film over the interlayer insulating film; and

forming a pixel electrode that is electrically connected to the source region or drain region through a contact hole over the interlayer film;

wherein the second heat treatment is performed in a temperature range not exceeding a glass transition point of the substrate.

82. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film on an insulating surface;

providing the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

performing a first heat treatment to crystallize the amorphous semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film while a second portion of the crystalline semiconductor film is not provided with the impurity element;

wherein the first and second portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

performing a second heat treatment for gettering so that the element contained in the first portion is moved to the second portion in a direction parallel to the insulating surface;

patterning the crystallized semiconductor film to form a crystalline semiconductor island in the second portion thereby removing the first portion of the crystalline semiconductor film; and

forming an active layer of the thin film transistor using the crystalline semiconductor island.

88. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film on an insulating surface;

providing the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

performing a first heat treatment to crystallize the amorphous semiconductor;

irradiating a laser light or an intense light to the crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film after the irradiating step, while a second portion of the crystalline semiconductor film is not provided with the impurity element;

wherein the first and second portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

performing a second heat treatment for gettering so that the element contained in the second portion is moved to the first portion in a lateral direction to the insulating surface;

patterning the crystalline semiconductor film to form a crystalline semiconductor island in the second portion thereby removing the second portion of the crystalline semiconductor film; and

forming an active layer of the thin film transistor using the crystalline semiconductor island.

94. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film on an insulating surface;

providing the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

performing a first heat treatment to crystallize the amorphous semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film while a second portion of the crystalline semiconductor film is not provided with the impurity element;

wherein the first and second portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

performing a second heat treatment for gettering so that the element contained in the second portion is moved to the first portion in a direction parallel to the insulating surface;

forming a crystalline semiconductor island by removing the first portion and a part of the second portion; and

forming an active layer of the thin film transistor using the crystalline semiconductor island.

100. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film on an insulating surface;

providing the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

performing a first heat treatment to crystallize the amorphous semiconductor;

irradiating a laser light or an intense light to the crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film after the irradiating step, while a second portion of the crystalline semiconductor film is not provided with the impurity element;

wherein the first and second portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

performing a second heat treatment for gettering so that the element contained in the second portion is moved to the first portion in a lateral direction to the insulating surface;

forming a crystalline semiconductor island by removing the first portion and a part of the second portion; and

forming an active layer of the thin film transistor using the crystalline semiconductor island.